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ASSESSMENT OF RECOVERABLE COAL RESERVES

Estevan Coalfield, Saskatchewan

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FEBRUARY 1986

MAPS

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ENERGY RESEARCH PROGRAM
ENERGY RESEARCH LABORATORIES
DIVISION REPORT ERP/ERL 86-20(TR)

OCT 11 1988

MICROMEDIA

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INTRODUCTION

As partial fulfillment of the CANMET Mining Research Laboratories Energy Research Program, within the confines of the "Assessment of Coal Reserves and Production" project (Code 430100), the Mine Evaluation Group assessed the recoverable coal in the Estevan Coalfield of Saskatchewan. This coalfield has been subjected to evaluation exercises in the past. A comprehensive study was prepared cooperatively by the Geological Survey of Canada, the Department of Mineral Resources of Saskatchewan and the Saskatchewan Research Council in 1978(2). The study assessed the Estevan Coalfield in the frame of a regional project which covered the coal resources of the entire southern Saskatchewan. The resulting report (2) was based on data accumulated during a six year long drilling program. The accumulated data were made computer accessible and formed the basis also for several subsequent studies (3,4,5 and 6).

The rationale of the present report is the collective decision of representatives from the Saskatchewan Power Corporation, the EMR/CANMET Coal Research Laboratory and the EMR/CANMET Mine Evaluation Group. According to the decision the evaluation criteria for recoverable coal resource and reserve assessment in Saskatchewan were redefined. The redefined criteria are more restrictive than those which were used in the above mentioned previous assessments. Consequently, the estimated recoverable coal reserves of the Estevan Coalfield in the present report are less than those which were reported prerviously.

According to the assessment exercise, whose description and findings are summarised in this report, the recoverable coal reserves and resources of the Estevan Coalfield consist of 11 million tonnes of measured, 479 million tonnes of indicated and 95 million tonnes of inferred coal in five coal zones.

MATERIALS AND METHODS

Materials

The quantitative data, which were used in the present assessment of the Estevan Coalfield, were collected during a drilling campaign in 1972 and 1973 (705 holes) to which further data were added from both government and private sources. These additional data cover quantitative information from 1833 holes. The entire data were incorporated into a computer data file which is described in detail in Reference 2. The original computer data file was restructured into computer files compatible with the computer programs of the Mine Evaluation Group. These programs were developed by the Mine Evaluation Group in order to carry out reserve assessments with the utilization of the EMR computers. The modified computer data files and the various applied computer programs are described in References 5 and 6.

The evaluation criteria, applied in the present assessment, were defined by a sequence of oral and written consulations between officials of the following organizations, during the early months of 1984:

Saskatchewan Power Corporation

EMR/CANMET Coal Research Laboratory

EMR/CANMET/MRL Mine Evaluation Group

The defined evaluation criteria are described in detail in Appendix 2.

In order to delineate those areas from which the coal reserves were mined out, eleven 1:20 000 scale air photo composites were used. These composites were received from the Saskatchewan Power Corporation by the CANMET/Coal Research Laboratories, and, together with the composites a series of mineability restrictions, were communicated to the Mine Evaluation Group. These restrictions are detailed in a memorandum from the Coal Research Laboratory to the Mine Evaluation Group on March 23, 1984.

Methods

The recoverable coal reserves and resources of the Estevan Coalfield were evaluated in the present exercise according to the tenets of conventional reserve evaluation methods.

Areas, underlain by recoverable coal, were outlined according to predetermined specifications and restrictions. The outlined areas were measured. The resulting area measurements were multiplied by the arithmetic average recoverable coal thickness measurements. These averages were derived from individual recoverable coal thicknesses, found in the exploratory drill holes, located within the respective areas. The products of the multiplications, volumetric measures, were subsequently multiplied by a density factor to produce estimates of recoverable coal tonnages. The density factor was determined by officials of the Saskatchewan Power Corporation.

In the following sequence the step by step outline of the above summarized approach is detailed according to the numbering sequence of the attached maps.

Geological Coal Limits (Map MPE 84-1)

The geological outlines of the coal zones in the Estevan Coalfield, regardless of any mineability or recoverability restrictions, were digitized from the maps of Reference 2.

From the digitized data a computer-drawn map was prepared on the same scale (1:50,000) as the topographic maps which cover the evaluated area. This map shows the entire extent of all five coal zones in the Estevan Coalfield without any economical, technological or legal restrictions.

Non-mineable areas (Map MPE 84-2)

From various sources, i.e.,topographical maps and aerial photo composites, a digitized computer data file was prepared of the non-mineable areas of the Estevan Coalfield. This data file contains the lateral extent of river valleys, outside limits of existing open pit and underground coal mines, railroads, highways and powerlines, as well as the boundaries of the municipal areas. The data file was used to prepare a computer-drawn map on the 1:50,000 scale.

Sampling information (Map MPE 84-3)

From the computer drill hole data file, containing the exploratory drilling data information, a computer-drawn drill hole collar location map was prepared on 1:50,000 scale, showing the collar locations of all drill holes in the Estevan Coalfield.

Extent of coal-in-mineable seams (Maps MPE 84-4 to 84-8 incl.)

With consideration of the recoverable coal thickness specifications, imposed to segregate recoverable from non-recoverable coal, a computer drill hole data subfile was established. This subfile contains all exploratory drill holes in the five coal zones which contain coal in terms of the recoverability thickness restrictions. The subfile was further subdivided into five parts according to the five recognized coal zones in the Estevan Coalfield. From the five computer file parts drill hole collar location maps were drawn to a scale of 1:50,000, showing the drill hole collars in each of the coal zones. On each map the postulated zone of influence of indicated recoverable coal reserves were printed around each participating drill collar.

Areas underlain by recoverable coal (Maps MPE 84-9 to 84-13 incl.)

The areal extent of the recoverable coal in the Estevan Coalfield was determined by graphical correlation of three maps for each of the five coal zones. The map of geological coal limits (MPE 84-1), the map of the non-mineable areas(MPE 84-2) and the map of recoverable coal for each of the five coal zones (MPE 84-4,-5,-6,-7,or -8) were used to outline the areas. All five recoverable coal zone area outlines were digitized and, from the digitized data reserve category, maps were produced by computer plotting. The respective digitized data files were also used to calculate the extent of each area underlain by recoverable coal.

Areas with overlapping recoverable coal (Maps MPE 84-14 & -15)

From the nineteen coal zones, existing in the Estevan Coalfield, five are considered to be worthy of consideration for mining at present. These are within a depth range which is shallow enough to accommodate the mining technology presently conventional in the area. The present evaluation exercise assessed all of these five coal zones independently. The recoverable coal of all five coal zones was outlined on their respective maps (MPE 84-9 to 84-13 incl.). Since there are numerous areas where several coal zones with recoverable coal overlap each other, it seemed advisable that the overlapping areas should be outlined and mapped. To avoid overcrowding and possible consequent confusion of the overlapping areas mapping was done on two sheets instead of one. The extent of the individual overlapping areas was determined by juxtaposition, outlining, digitizing and measuring them. The digitized data were used for both the plotting and the calculating the size of the overlapping areas by the computer. The areas are shown on maps MPE 84-14 and MPE 84-15.

Collar location and waste/recoverable coal thicknesses (Maps MPE 84-16 to 84-20 incl.)

To facilitate the determination of ratio of the coal-covering waste thickness to the thickness of the recoverable coal covered by it, a drill hole collar location map was plotted by the computer for each of the five coal zones which were considered in the estimation of the recoverable coal in the Estevan Coalfield. The maps show the location of the drill hole collars, the thickness of the coal covering waste and the thickness of the recoverable coal for each hole which contributed to the estimated recoverable coal in the respective coal zone. The two thicknesses are expressed in meters and are rounded to the nearest tenth of a meter.

RESULTS

The recoverable coal of the Estevan Coalfield, as assessed by the present exercise, is summarized in Table 1.

A detailed distribution of the assessed recoverable coal according to the five coal zones which were considered in the present assessment, is tabulated in Table 2.

To facilitate decision making in such cases where only a singular coal zone is considered for actual mining, the recoverable coal which is included in the various coal zone overlaps, is summarized in Table 3. The large number of overlaps between coal zone pairs necessitated also a detailed tabulation. For this purpose the coal zone overlaps were distributed into nine pairs. The recoverable coal occuring in these nine coal zone overlap pairs, is shown in Table 4.

To date, three assessments of coal reserves of the Estevan Coalfield have been made, with publications of results. Each of the three assessment exercises was based on specific assessing parameters and was done according to a definite methodology. While the methodologies of the first and third assessments were somewhat similar, the second was based on a drastically different technique. Furthermore, the assessing parameters in each of the three cases were different from the two others.Consequently a comparison of the three assessment results, *in sensu stricto*, cannot be made. Despite this caveat a comparative table was developed which shows the difference between the three coal resource assessments in detail (Table 5). The reader of this table should keep in his mind however that the differences in it are not so much differences between coal resource quantities as they are differences between the initial assessing parameters to which the three assessments adhered.

The detailed results of the *stripping ratio* estimation of the Estevan Coalfield are attached to the present report as Appendix 1.

TABLE 1

SUMMARY OF COAL RESERVES AND RESOURCES

Estevan Coalfield

Individual Coal Zones

	Measured *(Million Tonnes)*	Indicated *(Million Tonnes)*	Inferred *(Million Tonnes)*
Short Creek	-	44 (43.98)	28 (27.99)
Roche Percee	-	63 (62.99)	18 (18.47)
Souris	-	74 (73.94)	14 (14.39)
Estevan	-	244 (243.87)	25 (25.28)
Boundary	11 (11.24)	53 (53.57)	10 (10.14)
TOTAL:	11	478	95

Note: The above figures have been rounded to the nearest million tonnes

TABLE 2
DETAILED COAL RESERVES
Estevan Coalfield

Short Creek Coal Zone

Surface Identification	*Surface (Km^2)*	*Thickness (Metre)*	*Tonnage ($\times 10^6$ Tonnes)*
IA-01	39.00	1.10	39.47
IA-02	1.60	1.10	1.62
IA-03	1.78	1.10	1.80
IA-04	1.08	1.10	1.09
NA-01	23.40	1.10	23.68
NA-02	2.85	1.10	2.88
NA-03	1.35	1.15	1.43

Roche Percee Coal Zone

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage ($\times 10^6$ Tonnes)
IB-01	48.01	1.03	45.49
IB-02	15.75	1.03	14.92
IB-03	2.71	1.03	2.57
NB-01	11.66	1.03	11.05
NB-02	1.33	1.03	1.26
NB-03	2.50	1.03	2.37
NB-04	1.93	1.03	1.83
NB-05	2.07	1.03	1.96

Souris Coal Zone

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage ($\times 10^6$ Tonnes)
IC-01	67.44	0.97	60.18
IC-02	11.13	0.97	9.93
IC-03	2.15	0.17	0.34
IC-04	0.97	1.11	0.99
IC-05	0.48	1.08	0.48
IC-06	0.94	0.53	0.46
IC-07	1.62	0.38	0.57
IC-08	1.49	0.24	0.33
IC-09	0.54	1.34	0.66
NC-01	10.48	0.97	9.35
NC-02	2.44	0.97	2.18
NC-03	1.04	0.97	0.93
NC-04	0.90	0.97	0.80
NC-05	0.50	0.97	0.45
NC-06	0.77	0.97	0.69

TABLE 3 (contd.)

Estevan Coal Zone

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage *($\times 10^6$ Tonnes)*
ID-01	27.56	2.37	60.09
ID-02	2.25	2.37	4.90
ID-03	16.18	1.78	26.50
ID-04	18.42	1.78	30.16
ID-05	5.87	0.56	3.02
ID-06	50.43	2.35	109.03
ID-08	0.66	3.58	2.17
ID-09	1.49	4.17	5.72
ID-10	2.12	1.16	2.26
ND-01	0.94	1.78	1.54
ND-02	0.58	1.78	0.95
ND-03	0.99	1.78	1.62
ND-04	5.17	1.78	8.47
ND-05	1.28	0.56	0.66
ND-06	0.93	1.16	0.99
ND-07	1.50	2.35	3.24
ND-08	1.47	2.35	3.18
ND-09	0.49	2.35	1.06
ND-10	1.19	2.35	2.57
ND-11	0.46	2.35	0.99

Boundary Coal Zone

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage *($\times 10^6$ Tonnes)*
IE-01	11.37	1.27	13.28
IE-02	1.26	0.31	0.36
IE-03	3.04	1.00	2.80
IE-04	6.43	1.13	6.68
IE-05	1.56	0.25	0.36
IE-06	3.52	0.25	0.81
IE-07	2.22	0.79	1.61
IE-08	14.15	0.73	9.50
IE-09	8.65	0.73	5.81
IE-10	26.96	0.34	8.43
IE-11	1.64	0.85	1.28
IE-12	2.53	1.13	2.63
ME-01	10.82	1.13	11.25
NE-01	1.62	1.13	1.68
NE-02	3.91	0.25	0.90
NE-03	1.31	0.79	0.95
NE-04	1.84	0.73	1.24
NE-05	5.88	0.73	3.95
NE-06	1.13	0.73	0.76
NE-07	0.76	0.73	0.51
NE-08	0.47	0.34	0.15

TABLE 3

SUMMARY OF OVERLAPPING COAL RESERVES

Estevan Coalfield

Overlaps of Coal Zones

	Measured *(Million Tonnes)*	Indicated *(Million Tonnes)*	Inferred *(Million Tonnes)*
Short Creek/Roche Percee	-	10 (9.76)	6 (6.14)
Short Creek/Souris	-	3 (3.50)	3 (3.13)
Short Creek/Estevan	-	-	0.3 (0.26)
Short Creek/Boundary	-	-	-
Roche Percee/Souris	-	58 (57.96)	15 (15.43)
Roche Percee/Estevan	-	6 (5.89)	1 (0.92)
Roche Percee/Boundary	-	0.4 (0.36)	-
Souris/Estevan	-	20 (20.10)	2 (2.45)
Souris/Boundary	-	1 (1.30)	1 (0.80)
Estevan/Boundary	-	94 (94.22)	25 (25.60)
TOTAL:	-	192.4	53.3

Note: The above figures have been rounded to the nearest million tonnes

TABLE 4

DETAILED COAL RESERVE OVERLAPS

Estevan Coalfield

Coal Zones: Short Creek/Roche Percee

Surface Identification	*Surface* (Km^2)	*Thickness (Metre)*	*Tonnage* ($\times 10^6$ *Tonnes*)
IAB-01	8.54	1.10	8.64
IAB-02	1.10	1.10	1.11
NAB-01	2.85	1.10	2.88
NAB-02	1.93	1.03	1.83
NAB-03	1.35	1.15	1.43

Coal Zones: Short Creek/Souris

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage ($\times 10^6$ *Tonnes*)
IAC-01	1.08	1.10	1.09
IAC-02	2.38	1.10	2.41
NAC-01	0.23	1.15	0.24
NAC-02	2.85	1.10	2.88

Coal Zones: Short Creek/Estevan

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage ($\times 10^6$ *Tonnes*)
NAD-01	0.25	1.15	0.26

Coal Zones: Roche Percee/Souris

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage ($\times 10^6$ *Tonnes*)
IBC-01	48.01	1.03	45.49
IBC-02	10.45	1.03	9.90
IBC-03	2.71	1.03	2.57
NBC-01	1.13	1.03	1.07
NBC-02	10.41	1.03	9.86
NBC-03	2.50	1.03	2.37
NBC-04	0.78	1.03	0.74
NBC-05	1.46	1.03	1.38

TABLE 4 (Contd.)

Coal Zones: Roche Percee/Estevan

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage *($\times 10^6$ Tonnes)*
IBD-01	0.62	1.03	0.59
IBD-02	1.13	1.03	1.07
IBD-03	4.47	1.03	4.24
NBD-01	0.97	1.03	0.92

Coal Zones: Roche Percee/Boundary

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage *($\times 10^6$ Tonnes)*
IBE-01	0.38	1.03	0.36

Coal Zones: Souris/Estevan

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage *($\times 10^6$ Tonnes)*
ICD-01	0.54	1.34	0.67
ICD-02	1.49	0.24	0.33
ICD-03	1.62	0.38	0.57
ICD-04	0.45	0.97	0.40
ICD-05	13.09	0.97	11.68
ICD-06	5.01	0.91	4.19
ICD-07	2.15	0.17	0.34
ICD-08	0.94	0.53	0.46
ICD-09	0.97	1.11	0.99
ICD-10	0.48	1.08	0.48
NCD-01	0.35	1.78	0.57
NCD-02	0.50	1.78	0.82
NCD-03	0.99	1.16	1.06

TABLE 4 (contd.)

Coal Zones: Souris/Boundary

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage *($\times 10^6$ Tonnes)*
ICE-01	0.14	0.38	0.05
ICE-02	0.48	1.08	0.48
ICE-03	1.01	0.53	0.49
ICE-04	0.39	0.79	0.28
NCE-01	0.90	0.97	0.80

Coal Zones: Estevan/Boundary

Surface Identification	Surface (Km^2)	Thickness *(Metre)*	Tonnage *($\times 10^6$ Tonnes)*
IDE-01	2.10	2.37	4.58
IDE-02	2.23	2.37	4.86
IDE-03	0.11	1.78	0.18
IDE-04	1.63	1.78	2.67
IDE-05	2.80	1.78	4.59
IDE-06	0.30	1.78	0.49
IDE-07	3.18	0.56	1.64
IDE-08	25.33	2.35	54.76
IDE-09	1.58	2.35	3.42
IDE-10	7.88	2.35	17.04
NDE-01	2.10	1.78	3.44
NDE-02	2.23	2.35	4.82
NDE-03	0.11	2.35	0.24
NDE-04	1.63	2.35	3.52
NDE-05	2.80	2.35	6.05
NDE-06	0.30	2.35	0.65
NDE-07	3.18	2.35	6.88

TABLE 5

COMPARISON OF THE PRESENT AND THE TWO PREVIOUS COAL RESERVE ESTIMATIONS

Estevan Coalfield

Coal Zone	Estimation Sources	Reserve Catagories in Million Tonnes Measured	Indicated	Inferred	TOTAL
Short Creek	GSC 1978	13.60	40.90	48.70	103.20
	MEG 1983	-	0.83	95.12	95.95
	MEG 1984	-	43.98	27.99	71.97
Roche Percee	GSC 1978	20.60	53.30	62.20	136.10
	MEG 1983	2.84	44.19	83.77	130.80
	MEG 1984	-	62.99	18.47	81.46
Souris	GSC 1978	26.30	42.10	22.40	90.80
	MEG 1983	109.51	19.01	4.25	132.77
	MEG 1984	-	73.94	14.39	88.33
Estevan	GSC 1978	174.00	296.60	229.60	673.20
	MEG 1983	303.13	76.40	28.38	407.91
	MEG 1984	-	243.87	25.28	269.15
Boundary	GSC 1978	75.40	64.60	74.80	214.80
	MEG 1983	54.36	27.35	8.10	89.81
	MEG 1984	11.25	53.57	10.14	74.96
All Zones	GSC 1978	309.90	497.50	437.70	1245.10
	MEG 1983	469.84	167.78	219.62	857.24
	MEG 1984	11.25	478.35	96.27	585.87
Difference	MEG84/GSC78	-298.65	-19.15	-341.43	-659.23
	MEG84/MEG83	-458.59	+310.57	-123.35	-271.37

Comparison after deduction of 7% of the total estimated coal reserves from the MEG84 estimation for railroads and power lines.

All Zones	MEG 1984	10.46	443.94	89.53	543.93
Difference	MEG84/GSC78	-299.44	-53.56	-348.17	-701.17
	MEG84/MEG83	-459.38	+276.16	-130.09	-313.31

DISCUSSION

The dependability and precision of the results of a reserve assessment exercise is a function of the parameters on what it is based namely, the quantitative primary data file. The quantitative primary data file is assembled during the drilling and sampling campaign on the area, in the present case the Estevan Coalfield, whose resource potential is investigated. Depending on the status of the resource project, drilling and sampling campaigns are loosely divided into three categories. According to this categorization there are exploratory, development and production drilling and sampling campaigns, whose dependability and precision increases in the same order. Using the collected quantitative results as a data base from an exploratory campaign one usually estimates *in situ* reserves. Data collected from a development drilling and sampling campaign offers a good base to estimate (mineable) reserves. Finally, a production drilling and sampling campaign produces quantitative data from which *recoverable* reserves can be estimated. This last type of drilling and sampling campaign usually occurs at a time when the decision is made to mine the investigated mineral resource and the actual mining and processing plant is either being constructed or already in operation on the mine site. The production drilling and sampling campaign then will usually continue during the entire active life of the mining project.

The detailed description of the drilling and sampling campaign on the Estevan Coalfield (Reference 2) clearly demonstrates that the campaign was an exploratory one. The sampling methodology, used during the campaign, is of such a nature that the collected data base from it could not support the estimation of mineable or recoverable coal reserves in the strict sense. To substantiate this generalization with a concrete example the reader is referred to Ref. 2, p.91:"Elevation uncertainty", which is postulated to be $\pm$ 0.3 meter($\pm$ 1 foot). In constrast to this precision the recoverability parameter, assigned to the present assessment exercise, is specified to the next 0.001 meter(0.003 foot). Similar order of magnitude precision differences exist between the other actually collected exploratory quantitative data items and the corresponding estimation parameters which were assigned to the present assessment exercise.

This short digression intends to emphasize that the dependability of a mineral reserve estimation depends singularly and exclusively on the precision of the primary quantitative data. Application of highly sophisticated estimation methods, designed to be used as tools of production planning in an actively producing mine, to a data base assembled from an exploratory drilling and sampling campaign will create a false sense of high dependability of the estimated reserve quantities.

CONCLUSIONS and RECOMMENDATIONS

The present assessment of recoverable coal in the Estevan Coalfield suffers from two shortcomings. First, the basic primary quantitative data lacks both the density and the precision necessary to support an assessment of recoverable coal. Second, the estimated recoverable coal is expressed in metric tonnages. To express estimated reserves in weight units the estimators must use a *density factor*. The *density factor* must have at least as strong and representative sampling support as the other estimating parameters, in the present case the area and thickness measurements. In the present case the Mine Evaluation Group had only an arbitrarily assigned *density factor* at its disposal, which was different from the *density factors* used in at least in one of the previous two resource assessments. The arbitrary nature of the applied density factor eliminated the possibility to assign any kind of statistical precision limits to the results of the assessment.

In consideration of the lack of representative sampling support of the *density factor*, it is recommended that any further estimations of the coal reserves in the Estevan Coalfield could be done in volumetric units instead of weight units. Later the volumetric units could be converted to weight units if it is desired. The conversion should be done in the form of a simple linear function, using a limited and realistically expectable range of *density factor* values as the independent variable of the function.

Furthermore, it is also recommended that *recoverable* coal should be assessed only in those minor parts of the Estevan Coalfield where the sampling density and precision warrant such an exercise. The overall estimation of coal reserves in the Estevan Coalfield should remain an *in situ* estimation until additional, more dense and more precise sampling will be done over the coalfield.

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APPENDIX 1

STRIPPING RATIO ESTIMATION OF THE ESTEVAN COALFIELD

It is presumed that any eventual mining of coal in the Estevan Coalfield will be done by strip mining methods. In strip mining, like in any other surface mining, the ratio of the reserve covering waste quantity to the quantity of reserve underneath is a primary factor of consideration in the decision making process concerned with the future of a mining project. This ratio is the ***stripping ratio***, expressed by a singular common fraction.

Over a large area, where numerous mining projects could be envisaged in the future, the concept of the ***stripping ratio*** becomes somewhat clouded. According to individual preference one could interpret it as the ratio of the average waste thickness to the average coal thickness or the average of the waste/coal thickness ratios. The first is equivalent to the ***stripping ratio*** of a singular mining project because the ratio of the average of all sampled waste thicknesses to the average of all sampled coal thicknesses is equal to the ratio of the total estimated waste to the total estimated coal. In other words, it is a ratio of averages . The second is the average of all individual waste/coal thickness ratios, calculated at each sampling point. This latter is an average ratio.

The ratio of averages and the average ratio are usually not equivalent, with the exception of two limiting cases. These limiting cases occur either if the array of all sampled waste thickness values is in perfect linear correlation with the array of all sampled coal thickness values, or if the linear correlation between the two sample arrays is totally lacking. In statistical parlance the correlation coefficient "r" in the first case is $\pm$ 1, in the second case it is 0.

It is customary that some variables, distributed over a large area, are contoured on maps or plans to facilitate the overview of their behaviour. During the estimation of the recoverable coal in the Estevan Coalfield it was suggested to the Mine Evaluation Group that the ***stripping ratio*** over the Estevan Coalfield should be also contoured, at least in those sub-areas where the density of the sampling points allows it. Unfortunately the detailed investigation of the waste/coal thickness ratios disclosed that contouring them as ***stripping ratios*** is not possible for the following reasons:

From the above described two concepts which could be substituted for the ***stripping ratio*** of a singular mining project regionally,i.e.,the ratio of averages and the average ratio, the first is a singular,invariable value. Consequently it is not contourable. The second would be contourable only if the denominator of the individual waste/coal thickness ratios of all considered sampling points would be constant. In such a case the

linear correlation coefficient "r" between the waste and coal thickness arrays would be zero. Such is not the case over the Estevan Coalfield. Even if such would be the case the contours over the area would not be *stripping ratio* or waste/coal thickness ratio contours. Rather, they would be properly named as waste thickness contours because only the waste thickness measurements would be variable.

To offer a quantitative overview about the behaviour of the two possible interpretation of the *stripping ratio* concept over the area to the users of the present estimation of the recoverable coal in the Estevan Coalfield, the waste/coal thickness ratios were calculated both as ratios of averages and as average ratios. The summary of both values in all five coal zones is tabulated in Table 6. The detailed tabulation of the two values for each individual coal zone are shown on Tables 7-11 inclusive.

TABLE 6
SUMMARY OF WASTE/COAL THICKNESS RATIOS
Estevan Coalfield

Coal Zone Surface Identification	Number of Drill Holes	Waste/Coal Ratio of Averages	Waste/Coal Average Ratio
Short Creek All Blocks	21	19.3	24.6
Roche Percee All Blocks	35	23.7	29.0
Souris			
IC-1	42	26.4	29.1
IC-2	6	48.2	51.4
IC-3	1	109.5	109.5
IC-4	4	5.96	6.03
IC-5	6	10.7	32.3
IC-6	2	12.4	16.5
IC-7	2	48.3	51.9
IC-8	2	72.2	78.5
IC-9	1	32.2	32.2
Estevan			
ID-1	35	14.9	29.0
ID-2	9	3.7	8.9
ID-3,ID-4	29	19.6	38.4
ID-5	3	67.5	131.6
ID-6	33	10.9	16.1
ID-8	4	9.0	9.1
ID-9	2	5.5	5.5
ID-10	1	34.1	34.1
Boundary			
IE-1	11	32.2	73.9
IE-2	1	147.7	147.7
IE-3	4	43.9	83.8
IE-5,IE-6	3	147.7	151.4
IE-7	2	53.6	85.8
IE-8	23	22.2	36.2
IE-10	18	113.2	126.2
IE-11	1	22.9	22.9
ME-1,IE-4 IE-12	56	15.3	16.6

TABLE 7
WASTE/COAL THICKNESS RATIOS
Estevan Coalfield

Short Creek Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ALL	0070	21.1	0.9	23.4
ALL	0074	18.6	0.7	26.6
ALL	0139	24.1	1.1	21.9
ALL	0141	29.0	1.1	26.4
ALL	0142	27.1	0.9	30.1
ALL	0186	18.9	0.2	94.5
ALL	0195	30.8	1.7	18.1
ALL	0196	30.2	1.6	18.9
ALL	0197	29.0	1.8	16.1
ALL	0198	26.6	1.7	15.6
ALL	0281	24.8	1.6	15.5
ALL	0357	22.1	0.6	36.8
ALL	0358	9.2	0.3	30.7
ALL	0391	21.6	1.4	15.4
ALL	1668	20.1	2.4	8.4
ALL	1669	13.5	1.3	10.4
ALL	1680	22.3	0.9	24.8
ALL	1681	23.2	1.2	19.3
ALL	1682	4.0	0.3	13.3
ALL	1683	9.8	0.3	32.7
ALL	2201	22.6	1.3	17.4
TOTAL:	21	448.6	23.3	516.3

Ratio of Averages: 19.3

Average Ratio: 24.6

TABLE 8
WASTE/COAL THICKNESS RATIOS
Estevan Coalfield

Roche Percee Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ALL	0074	49.8	0.3	166.0
ALL	0076	26.0	1.4	18.6
ALL	0077	15.7	0.8	19.6
ALL	0119	3.5	0.9	3.9
ALL	0120	15.5	1.0	15.5
ALL	0122	12.2	0.6	20.3
ALL	0123	22.3	1.1	20.3
ALL	0143	14.7	1.2	12.2
ALL	0181	25.6	0.9	28.4
ALL	0182	12.3	0.5	24.6
ALL	0184	18.2	0.8	22.8
ALL	0185	31.9	1.1	29.0
ALL	0186	48.8	1.2	40.7
ALL	0193	8.3	0.5	16.6
ALL	0194	40.5	1.4	28.9
ALL	0199	16.4	1.3	12.6
ALL	0276	28.4	0.9	31.6
ALL	0309	7.6	1.1	6.9
ALL	0354	22.2	1.4	15.9
ALL	0358	34.7	1.5	23.1
ALL	0392	22.5	1.3	17.3
ALL	0610	16.9	1.2	14.1
ALL	0636	28.1	0.5	56.2
ALL	0764	29.2	2.1	13.9
ALL	1665	22.0	0.3	73.3
ALL	1666	32.7	1.0	32.7
ALL	1667	24.2	1.3	18.6
ALL	1682	36.3	0.9	40.3
ALL	1683	39.7	0.9	44.1
ALL	1685	18.4	1.2	15.3
ALL	1686	31.9	0.7	45.6
ALL	1687	12.9	1.0	12.9
ALL	1688	26.3	0.8	32.9
ALL	1689	17.7	0.9	19.7
ALL	1728	34.1	1.8	18.9
TOTAL:	35	847.5	35.8	1013.4

Ratio of Averages: 23.7

Average Ratio: 29.0

TABLE 9
WASTE/COAL THICKNESS RATIOS
Estevan Coalfield

Souris Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-01	0048	9.2	1.2	7.7
IC-01	0392	31.3	0.9	34.8
IC-01	0610	29.5	1.2	24.6
IC-01	0123	30.8	1.0	30.8
IC-01	1666	42.1	0.9	46.8
IC-01	0120	30.7	1.3	23.6
IC-01	0193	23.7	1.0	23.7
IC-01	1686	46.4	0.7	66.3
IC-01	0121	20.6	1.0	20.6
IC-01	0194	47.9	1.3	36.8
IC-01	0182	25.6	0.6	42.7
IC-01	0199	34.1	1.0	34.1
IC-01	0122	33.2	0.7	47.4
IC-01	1688	35.7	0.7	51.0
IC-01	0764	40.3	0.9	44.8
IC-01	1655	10.1	1.1	9.2
IC-01	0181	45.3	0.5	90.6
IC-01	0117	11.6	1.5	7.7
IC-01	1662	20.5	1.7	12.1
IC-01	1685	32.7	1.0	32.7
IC-01	0160	10.3	1.0	10.3
IC-01	1665	34.8	0.9	38.7
IC-01	0119	21.1	0.7	30.1
IC-01	0111	24.8	1.1	22.5
IC-01	1726	8.0	1.1	7.3
IC-01	0309	22.5	1.2	18.8
IC-01	0354	32.6	1.2	27.2
IC-01	0116	11.0	1.1	10.0
IC-01	1727	7.4	1.0	7.4
IC-01	0158	8.5	1.3	6.5
IC-01	1684	43.9	1.2	36.6
IC-01	0636	39.1	1.0	39.1
IC-01	1667	33.9	0.8	42.4
IC-01	1689	35.1	0.7	50.1
IC-01	1656	5.6	0.9	6.2
IC-01	1658	14.7	1.1	13.4
IC-01	1725	4.3	0.3	14.3
IC-01	0077	25.0	1.4	17.9
IC-01	1659	23.5	0.6	39.2
IC-01	0164	17.1	1.0	17.1
IC-01	0276	41.8	0.9	46.4
IC-01	0184	37.6	1.1	34.2
TOTAL:	42	1103.9	41.8	1223.6

Ratio of Averages: 26.4 Average Ratio: 29.1

TABLE 9 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Souris Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-02	0185	36.9	0.9	41.0
IC-02	1728	43.0	0.8	53.8
IC-02	0076	33.0	1.2	27.5
IC-02	1683	44.9	0.6	74.8
IC-02	0358	41.2	0.7	58.9
IC-02	1682	41.8	0.8	52.3
TOTAL:	6	240.8	5.0	308.2

Ratio of Averages: 48.2

Average Ratio: 51.4

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-03	0143	21.9	0.2	109.5
TOTAL:	1	21.9	0.2	109.5

Ratio of Averages: 5.5

Average Ratio: 5.5

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-04	0635	4.2	0.7	6.0
IC-04	0124	9.5	1.8	5.3
IC-04	2191	3.1	0.5	6.2
IC-04	2190	10.0	1.5	6.7
TOTAL:	4	26.8	4.5	24.1

Ratio of Averages: 5.96

Average Ratio: 6.03

TABLE 9 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Souris Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-05	2195	7.7	0.3	25.7
IC-05	0125	13.7	2.1	6.5
IC-05	2187	6.2	2.1	3.0
IC-05	2196	20.0	0.2	100.0
IC-05	2198	4.0	1.4	2.9
IC-05	2197	16.7	0.3	55.7
TOTAL:	6	68.3	6.4	193.7

Ratio of Averages: 10.7

Average Ratio: 32.3

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-06	1678	7.7	0.3	25.7
IC-06	1677	5.9	0.8	7.4
TOTAL:	2	13.6	1.1	33.0

Ratio of Averages: 12.4

Average Ratio: 16.5

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-07	0159	18.7	0.5	37.4
IC-07	1600	19.9	0.3	66.3
TOTAL:	2	38.6	0.8	103.7

Ratio of Averages: 48.3

Average Ratio: 51.9

TABLE 9 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Souris Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-08	0642	14.1	0.3	47.0
IC-08	1690	22.0	0.2	110.0
TOTAL:	2	36.1	0.5	157.0

Ratio of Averages: 72.2

Average Ratio: 78.5

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IC-09	0637	41.9	1.3	32.2
TOTAL:	1	41.9	1.3	32.2

Ratio of Averages: 32.2

Average Ratio: 32.2

TABLE 10
WASTE/COAL THICKNESS RATIOS
Estevan Coalfield

Estevan Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ID-01	0109	23.3	0.3	77.7
ID-01	0165	49.7	1.9	26.2
ID-01	0103	23.2	2.5	9.3
ID-01	1605	41.8	0.3	139.3
ID-01	0557	48.9	1.1	44.5
ID-01	1691	30.0	3.6	8.3
ID-01	0106	38.9	3.4	11.4
ID-01	1653	38.1	3.1	12.3
ID-01	0108	39.6	2.1	18.9
ID-01	1652	41.2	2.5	16.5
ID-01	1649	43.4	0.3	144.7
ID-01	1690	36.3	3.4	10.7
ID-01	1604	34.2	1.6	21.4
ID-01	0642	30.6	2.9	10.6
ID-01	1650	38.5	3.0	12.8
ID-01	0072	35.0	3.2	10.9
ID-01	1601	31.2	0.5	62.4
ID-01	1636	42.2	3.3	12.8
ID-01	0048	34.1	2.7	12.6
ID-01	0159	38.4	2.7	14.2
ID-01	1602	25.2	2.8	9.0
ID-01	1639	28.8	3.5	8.2
ID-01	0560	24.1	3.9	6.2
ID-01	1603	40.0	2.0	20.0
ID-01	1638	32.8	3.4	9.6
ID-01	1635	31.8	3.2	9.9
ID-01	1654	39.0	3.1	12.6
ID-01	1606	43.8	2.5	17.5
ID-01	0168	45.3	3.1	14.6
ID-01	1600	34.9	3.4	10.3
ID-01	1598	40.2	3.4	11.8
ID-01	0173	42.0	2.0	21.0
ID-01	1724	32.1	3.0	10.7
ID-01	1663	26.6	0.3	88.7
ID-01	1599	35.1	0.4	87.7
TOTAL:	35	1260.3	84.4	1015.3

Ratio of Averages: 14.9

Average Ratio: 29.0

TABLE 10 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Estevan Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ID-02	1811	4.3	0.2	21.5
ID-02	0170	14.0	2.2	6.4
ID-02	0277	7.7	2.4	3.2
ID-02	1837	4.6	2.2	2.1
ID-02	0062	4.9	1.8	2.7
ID-02	1835	7.4	0.2	37.0
ID-02	1833	7.2	2.3	3.1
ID-02	1838	6.7	2.5	2.7
ID-02	0083	5.0	2.8	1.8
TOTAL:	9	61.8	16.6	80.5

Ratio of Averages: 3.7

Average Ratio: 8.9

TABLE 10 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Estevan Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ID-04	0604	35.0	2.8	12.5
ID-04	0111	48.7	0.8	60.9
ID-04	1727	30.6	3.6	8.5
ID-04	0556	34.5	0.9	38.3
ID-04	0555	36.2	2.5	14.5
ID-04	1661	31.2	0.5	62.4
ID-04	0160	33.0	2.2	15.0
ID-04	0161	28.2	3.2	8.8
ID-04	0099	21.8	3.8	5.7
ID-04	1726	27.8	0.5	55.6
ID-04	0156	9.2	0.2	46.0
ID-04	0119	49.3	1.2	41.1
ID-04	1657	46.7	1.2	38.9
ID-04	0121	34.8	0.4	87.0
ID-04	0122	49.9	0.2	249.5
ID-04	1659	44.2	2.8	15.8
ID-04	0495	19.4	3.7	5.2
ID-04	1658	37.0	3.2	11.6
ID-04	0115	11.1	2.0	5.6
ID-04	0164	44.4	1.1	40.4
ID-04	0155	33.5	1.4	23.9
ID-04	1725	38.3	0.6	63.8
ID-04	1673	27.1	1.2	22.6
ID-04	0117	43.9	1.3	33.8
ID-04	0116	33.0	1.3	25.4
ID-04	1656	29.4	2.1	14.0
ID-04	1655	30.2	2.9	10.4
ID-04	1662	40.3	0.5	80.6
ID-04	0552	46.1	2.7	17.1
TOTAL:	29	994.8	50.8	1114.8

Ratio of Averages: 19.6

Average Ratio: 38.4

TABLE 10 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Estevan Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ID-05	1675	31.5	1.3	24.2
ID-05	0193	47.7	0.3	159.0
ID-05	0077	42.3	0.2	211.5
TOTAL:	3	121.5	1.8	394.7

Ratio of Averages: 67.5

Average Ratio: 131.6

TABLE 10 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Estevan Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ID-06	0134	13.1	1.2	10.9
ID-06	0124	46.7	3.5	13.3
ID-06	0390	23.7	2.9	8.2
ID-06	0496	17.4	3.1	5.6
ID-06	2191	38.9	3.1	12.5
ID-06	0125	39.7	3.8	10.4
ID-06	0163	19.0	1.9	10.0
ID-06	0638	31.1	1.5	20.7
ID-06	0137	24.9	2.4	10.4
ID-06	0154	19.3	0.3	64.3
ID-06	0126	28.5	3.3	8.6
ID-06	2193	33.3	2.9	11.5
ID-06	0640	36.4	3.3	11.0
ID-06	0127	10.9	2.9	3.8
ID-06	0131	14.5	2.6	5.6
ID-06	2197	29.4	3.6	8.2
ID-06	0497	21.0	1.4	15.0
ID-06	0151	14.0	0.6	23.3
ID-06	1678	31.5	0.5	63.0
ID-06	0132	41.1	3.3	12.5
ID-06	1679	16.5	0.2	82.5
ID-06	0153	37.3	2.9	12.9
ID-06	0133	31.2	2.6	12.0
ID-06	0152	11.8	1.8	6.6
ID-06	2196	36.5	3.6	10.1
ID-06	0639	3.7	2.0	1.9
ID-06	0635	39.4	1.8	21.9
ID-06	2194	36.1	2.5	14.4
ID-06	0389	11.7	2.1	5.6
ID-06	0145	26.8	2.0	13.4
ID-06	0388	14.6	1.7	8.6
ID-06	0128	3.7	1.9	1.9
ID-06	2195	29.8	3.2	9.3
TOTAL:	33	833.5	76.4	530.0

Ratio of Averages: 10.9

Average Ratio: 16.1

TABLE 10 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Estevan Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ID-08	0150	32.8	3.7	8.9
ID-08	2200	33.8	4.0	8.4
ID-08	2187	31.5	3.7	8.5
ID-08	2188	32.8	3.1	10.6
TOTAL:	4	130.9	14.5	36.4

Ratio of Averages: 9.0

Average Ratio: 9.1

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ID-09	0355	24.0	4.1	5.9
ID-09	0144	21.6	4.2	5.1
TOTAL:	2	45.6	8.3	11.0

Ratio of Averages: 5.5

Average Ratio: 5.5

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ID-10	0143	40.9	1.2	34.1
TOTAL:	1	40.9	1.2	34.1

Ratio of Averages: 34.1

Average Ratio: 34.1

TABLE 11
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Boundary Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IE-01	1641	48.9	1.5	32.6
IE-01	0175	45.9	1.2	38.3
IE-01	0112	44.7	1.4	31.9
IE-01	0169	34.1	0.2	170.5
IE-01	1645	29.0	3.7	7.8
IE-01	0113	49.6	0.5	99.2
IE-01	0110	39.9	0.3	133.0
IE-01	1648	43.4	2.0	21.7
IE-01	1643	44.3	0.3	147.7
IE-01	1642	34.8	0.3	116.0
IE-01	1644	36.0	2.6	13.8
TOTAL:	11	450.6	14.0	812.5

Ratio of Averages: 32.2

Average Ratio: 73.9

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IE-02	0104	44.3	0.3	147.7
TOTAL:	1	44.3	0.3	147.7

Ratio of Averages: 147.7

Average Ratio: 147.7

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IE-03	1634	44.7	2.0	22.4
IE-03	1639	47.2	1.4	33.7
IE-03	1638	50.2	0.3	167.3
IE-03	0103	33.6	0.3	112.0
TOTAL:	4	175.7	4.0	335.4

Ratio of Averages: 43.9

Average Ratio: 83.8

TABLE 11 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Boundary Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IE-05	0115	27.0	0.2	135.0
IE-05	1673	37.6	0.3	125.3
IE-05	0156	38.8	0.2	194.0
TOTAL:	3	103.4	0.7	454.3

Ratio of Averages: 147.7

Average Ratio: 151.4

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IE-07	1676	44.5	1.3	34.2
IE-07	1675	41.2	0.3	137.3
TOTAL:	2	85.7	1.6	171.6

Ratio of Averages: 53.6

Average Ratio: 85.8

TABLE 11 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Boundary Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IE-08	0152	26.9	0.3	89.7
IE-08	0646	12.6	0.3	42.0
IE-08	1623	15.7	1.2	13.1
IE-08	1624	14.4	0.4	36.0
IE-08	0389	26.8	0.4	67.0
IE-08	0127	20.5	0.4	51.3
IE-08	0071	12.1	0.6	20.2
IE-08	0130	18.1	0.3	60.3
IE-08	0643	10.4	0.9	11.6
IE-08	1628	8.6	0.9	9.6
IE-08	1670	11.7	1.7	6.9
IE-08	0548	18.3	1.3	14.1
IE-08	1622	12.6	0.4	31.5
IE-08	1629	9.8	0.4	24.5
IE-08	1671	22.3	0.4	55.7
IE-08	0561	9.8	0.4	24.5
IE-08	1619	32.4	0.3	108.0
IE-08	0645	15.3	0.3	51.0
IE-08	1627	19.6	2.1	9.3
IE-08	1625	13.1	1.6	8.2
IE-08	0644	11.0	1.1	10.0
IE-08	1626	13.8	1.0	13.8
IE-08	0388	22.3	0.3	74.3
TOTAL:	23	378.1	17.0	832.5

Ratio of Averages: 22.2

Average Ratio: 36.2

TABLE 11 cont'd
WASTE/COAL THICKNESS RATIOS

Estevan Coalfield

Boundary Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IE-10	1678	45.9	0.6	76.5
IE-10	0134	39.0	0.4	97.5
IE-10	1677	36.6	0.3	122.0
IE-10	2196	49.0	0.3	163.3
IE-10	0133	47.1	0.3	157.0
IE-10	1679	32.1	0.2	160.5
IE-10	0496	27.3	0.3	91.0
IE-10	2197	48.6	0.5	97.2
IE-10	0145	37.7	0.2	188.5
IE-10	0151	30.9	0.3	103.0
IE-10	0640	49.8	0.8	62.3
IE-10	0497	46.8	0.3	156.0
IE-10	0131	34.9	0.2	174.5
IE-10	2187	49.9	0.5	99.8
IE-10	2195	37.9	0.2	189.5
IE-10	0128	19.0	0.2	95.0
IE-10	0154	44.0	0.3	146.7
IE-10	0390	36.8	0.4	92.0
TOTAL:	18	713.3	6.3	2272.3

Ratio of Averages: 113.2

Average Ratio: 126.2

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
IE-11	0639	20.6	0.9	22.9
TOTAL:	1	20.6	0.9	22.9

Ratio of Averages: 22.9

Average Ratio: 22.9

TABLE 11 con'td
WASTE/COAL THICKNESS RATIOS
Estevan Coalfield

Boundary Coal Zone

Surface Identification	Drill Hole Number	Waste Thickness	Coal Thickness	Waste/Coal Ratio
ME-01	1592	19.8	0.9	22.0
ME-01	1613	11.7	0.9	13.0
ME-01	0170	35.3	1.4	25.2
ME-01	1826	14.1	1.3	10.8
ME-01	1817	12.7	1.0	12.7
ME-01	1593	20.7	0.7	29.6
ME-01	1818	13.5	1.3	10.4
ME-01	1808	12.2	1.1	11.1
ME-01	1809	14.7	1.0	14.7
ME-01	1832	19.1	1.3	14.7
ME-01	1612	18.1	1.0	18.1
ME-01	1807	12.8	1.2	10.7
ME-01	1816	13.8	0.8	17.3
ME-01	1825	19.1	1.0	19.1
ME-01	1831	13.8	1.2	11.5
ME-01	1723	12.9	0.4	32.3
ME-01	1806	3.9	1.6	2.4
ME-01	1607	4.6	1.0	4.6
ME-01	1835	22.7	1.1	20.6
ME-01	1829	10.2	1.0	10.2
ME-01	1609	13.7	1.1	12.5
ME-01	1822	6.3	1.4	4.5
ME-01	1813	23.8	1.0	23.8
ME-01	1802	13.0	0.7	18.6
ME-01	1618	17.9	0.9	19.9
ME-01	1824	22.2	1.1	20.2
ME-01	1815	16.5	1.0	16.5
ME-01	0167	8.7	2.0	4.3
ME-01	1805	26.4	0.9	29.3
ME-01	1610	25.0	0.8	31.3
ME-01	1830	19.0	1.0	19.0
ME-01	1804	18.4	2.0	9.2
ME-01	0157	22.5	1.2	18.8
ME-01	1823	12.6	1.2	10.5
ME-01	1814	21.8	1.9	11.5
ME-01	1615	10.5	1.5	7.0
ME-01	1596	22.3	1.3	17.2
ME-01	1828	12.6	0.9	14.0
ME-01	1834	21.7	1.2	18.1
ME-01	1608	23.6	1.0	23.6
ME-01	1821	8.1	1.5	5.4
ME-01	0608	22.0	0.9	24.4
ME-01	1617	23.5	1.3	18.1

ME-01	1812	23.0	1.2	19.2
ME-01	0073	14.5	0.7	20.7
ME-01	1810	16.7	1.4	11.9
ME-01	1614	9.8	1.1	8.9
ME-01	1595	18.1	0.8	22.6
ME-01	1827	22.4	0.9	24.9
ME-01	1833	29.6	1.1	26.9
ME-01	1646	23.5	0.8	29.4
ME-01	1820	12.5	1.6	7.8
ME-01	1811	24.7	1.3	19.0
ME-01	1837	22.9	0.9	25.4
ME-01	1819	13.1	1.3	10.1
ME-01	1616	12.2	0.8	15.3
TOTAL:	56	960.8	62.9	930.6

Ratio of Averages: 15.3

Average Ratio: 16.6

APPENDIX 2

EVALUATION CRITERIA

The following evaluation criteria were used in the estimation of the recoverable coal in the Estevan Coalfield:

Mining Parameters

Coal specific gravity: 1.28, assuming 36% moisture and 9.5% ash.

Zone of Influence around an individual drill hole

Measured: < 0.4 km

Indicated: < 0.8 km

Inferred: > 0.8 < 4.8 km

Maximum mining depth : 50 meters

Recoverable Coal Thickness Restrictions

Minimum thickness of a single seam: 150 centimeters

Minimum thickness of a mineable seam : 45.7 centimeters

(with a loss of 22.8 centimeters on the top and 7.6 centimeters on the bottom)

Parting:

-cannot exceed a stripping ratio of 2:1 with respect to a coal seam beneath it.

-partings of 7.6 centimeters or more are to be removed.

Non-mineable Area Definitions

-Allowance of 30 meters is made to the crest of river valleys and to the back of underground mines or pits.

-Allowances of 100 meters from centreline of railroads and centreline of 230 and 138 kV power lines.

-Areas within town and airport limits.

Comments

Considering the scale at which estimations of the recoverable coal were done the individual assessment of each narrow band of non-mineable area was not carried out. Instead 7% of estimated recoverable coal were deducted to allow for all narrow negative areas, i.e., power lines and railroads. The average influence areas are tabulated on Table 12.

TABLE 12

SUMMARY OF AVERAGE AREA OF INFLUENCE PER DRILL HOLE

Estevan Coalfield

Surface Identification	Number of Drill Hole	Total Area (km^2)	Area/Hole (km^2)
IA-1 TO IA-4	21	43.46	2.07
IB-1 TO IB-2	35	66.47	1.90
IC-1	42	67.44	1.61
IC-2	6	11.13	1.86
IC-3	1	2.15	2.15
IC-4	4	0.97	0.24
IC-5	6	0.48	0.08
IC-6	2	0.94	0.47
IC-7	2	1.62	0.81
IC-8	2	1.49	0.75
IC-9	1	0.54	0.54
ID-1	35	27.56	0.79
ID-2	9	2.25	0.25
ID-3 TO ID-4	29	34.60	1.19
ID-5	3	5.87	1.96
ID-6	33	50.43	1.53
ID-8	4	0.66	0.17
ID-9	2	1.49	0.75
ID-10	1	2.12	2.12
IE-1	11	11.37	1.03
IE-2	1	1.26	1.26
IE-3	4	3.04	0.76
IE-5	3	1.56	0.52
IE-7	2	2.22	1.11
IE-8	23	14.15	0.62
IE-10	18	29.96	1.50
IE-11	1	6.57	6.57
TOTAL:	301	391.80	

Overall Average/Hole : 391.80/301=1.30 km^2
For Indicated Category

ME-1,IE-4 IE-12	56	19.78	0.35

Overall Average Area/Hole : 19.78/56=0.35 km^2
For Measured Category

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